

WHAT IS CLAIMED IS:

- 1 1. A method of processing an input image, comprising:
2 computing spatially-shifted forward transforms of the input image, each
3 forward transform being computed based on a denoiser transform Z having an
4 associated transpose Z' , wherein a matrix multiplication between Z and Z'
5 produces a diagonal matrix Λ , $Z = F(D)$, F specifies a mapping from coefficients of
6 D to coefficients of Z , and D substantially corresponds to a frequency-domain
7 transform;
8 denoising the forward transforms based on nonlinear mappings derived
9 from quantization values linked to the input image;
10 computing spatially-shifted inverse transforms of the denoised forward
11 transforms, each inverse transform being computed based on Z and Z' ; and
12 computing an output image based on a combination of spatially-shifted
13 inverse transforms.

- 1 2. The method of claim 1, wherein D is a block-based linear transform.

- 1 3. The method of claim 2, wherein the spatially-shifted forward
2 transforms are computed based on different respective blocking grids and the
3 spatially-shifted inverse transforms are computed based on blocking grids used to
4 compute corresponding spatially-shifted forward transforms.

- 1 4. The method of claim 2, wherein D is a discrete cosine transform.

- 1 5. The method of claim 3, wherein D is a one-dimensional discrete
2 cosine transform.

- 1 6. The method of claim 5, wherein F is an arithmetic operator.

- 1 7. The method of claim 6, wherein F is a rounding arithmetic operator.

- 1 8. The method of claim 1, wherein F is a mapping from coefficients of
2 D to corresponding coefficients of Z having values selected from 0 and $\pm 2^N$ where
3 N has an integer value.

1 9. The method of claim 1, wherein F is a mapping from weighted
2 coefficients of D to corresponding coefficients of Z.

1 10. The method of claim 9, wherein the coefficient of D are weighted by
2 a common scaling factor.

1 11. The method of claim 10, wherein F corresponds to a rounding
2 operator applied to the weighted coefficients of D.

1 12. The method of claim 10, wherein the nonlinear mappings are
2 derived from quantization values weighted by the common scaling factor.

1 13. The method of claim 9, wherein the forward transforms are
2 denoised based on nonlinear mappings derived from quantization values linked to
3 the input image and weighted by respective scaling factors.

1 14. The method of claim 1, wherein the forward transforms are
2 computed based on a factorization of Z.

1 15. The method of claim 1, wherein the input image corresponds to a
2 decompressed version of an input image compressed based on a given
3 quantization process and the forward transforms are denoised based on the given
4 quantization process.

1 16. The method of claim 1, wherein the forward transforms are
2 denoised by setting to zero each forward transform coefficient with an absolute
3 value below a respective threshold derived from a respective quantization value
4 linked to the input image and leaving unchanged each forward transform
5 coefficient with an absolute equal to at least a respective threshold derived from a
6 respective quantization value linked to the input image.

1 17. The method of claim 16, further comprising sharpening the forward
2 transform coefficients by increasing nonlinear transform parameters by respective
3 factors that are larger for higher spatial frequency forward transform coefficients
4 than for lower spatial frequency forward transform coefficients.

1 18. The method of claim 1, wherein the output image is computed from
2 a weighted combination of the inverse transforms.

1 19. The method of claim 18, wherein the computed output image
2 corresponds to an average of the inverse transforms.

1 20. The method of claim 1, wherein computing the output image
2 comprises computing a base image from a combination of inverse transforms.

1 21. The method of claim 20, wherein the base image has pixel values
2 corresponding to respective averages of values of corresponding pixels in the
3 inverse transforms.

1 22. The method of claim 20, wherein computing the output image
2 further comprises computing a ringing correction image based at least in part on
3 computed measures of local spatial intensity variability for pixels of each of the
4 inverse transforms.

1 23. The method of claim 22, further comprising assigning to each pixel
2 in the ringing correction image a value of a corresponding intermediate image
3 pixel having a lowest computed measure of local spatial intensity variability of the
4 corresponding intermediate image pixels.

1 24. The method of claim 22, further comprising assigning to each pixel
2 in the ringing correction image a value corresponding to an average of multiple
3 corresponding intermediate image pixels in a lowest percentile of local spatial
4 variability measures of the corresponding intermediate image pixels.

1 25. The method of claim 22, wherein the output image is computed by
2 combining pixel values from the base image and the ringing correction image.

1 26. The method of claim 25, wherein the output image is computed by a
2 weighted combination of the base image and the ringing correction image.

1 27. The method of claim 14, wherein the base image contribution to the
2 output image is less than the ringing correction image contribution for pixels
3 adjacent to transition regions in the base image.

1 28. A system for processing an input image, comprising:
2 a forward transform module configured to compute spatially-shifted
3 forward transforms of the input image, each forward transform being computed
4 based on a denoiser transform Z having an associated transpose Z' , wherein a
5 matrix multiplication between Z and Z' produces a diagonal matrix Λ , $Z = F(D)$, F
6 specifies a mapping from coefficients of D to coefficients of Z , and D substantially
7 corresponds to a frequency-domain transform;

8 a nonlinear denoiser module configured to denoise the forward transforms
9 based on nonlinear mappings derived from quantization values linked to the input
10 image;

11 an inverse transform module configured to compute spatially-shifted
12 inverse transforms of the denoised forward transforms based on Z and Z' ; and
13 an output image generator module configured to compute an output image
14 based on a combination of spatially-shifted inverse transforms.

1 29. A system for processing an input image, comprising:
2 means for computing spatially-shifted forward transforms of the input
3 image, each forward transform being computed based on a denoiser transform Z
4 having an associated transpose Z' , wherein a matrix multiplication between Z and
5 Z' produces a diagonal matrix Λ , $Z = F(D)$, F specifies a mapping from coefficients
6 of D to coefficients of Z , and D substantially corresponds to a frequency-domain
7 transform;

8 means for denoising the forward transforms based on nonlinear mappings
9 derived from quantization values linked to the input image;

10 means for computing spatially-shifted inverse transforms of the denoised
11 forward transforms, each inverse transform being computed based on Z and Z' ;
12 and

13 means for computing an output image based on a combination of spatially-
14 shifted inverse transforms..

1 30. A machine-readable medium storing machine-readable instructions
2 for causing a machine to:

3 compute spatially-shifted forward transforms of the input image, each
4 forward transform being computed based on a denoiser transform Z having an
5 associated transpose Z' , wherein a matrix multiplication between Z and Z'
6 produces a diagonal matrix Λ , $Z = F(D)$, F specifies a mapping from coefficients of
7 D to coefficients of Z , and D substantially corresponds to a frequency-domain
8 transform;

9 denoise the forward transforms based on nonlinear mappings derived from
10 quantization values linked to the input image;

11 compute spatially-shifted inverse transforms of the denoised forward
12 transforms based on Z and Z' ; and

13 compute an output image based on a combination of spatially-shifted
14 inverse transforms.